

WHAT IS CLAIMED IS:

1. A thin film magnetic memory device, comprising:
a plurality of memory cells each having an electric resistance value varying according to a storage data level;
a dummy memory cell for producing a read reference voltage, said dummy memory cell including a plurality of cell units each having a same structure as that of said memory cell, and said plurality of cell units retaining storage data of different levels at least on a one-by-one basis;
a first data line connected to a selected one of said plurality of memory cells in data read operation;
a second data line connected to said dummy memory cell; and
a data read circuit for sensing a voltage difference between said first and second data lines.
2. The thin film magnetic memory device according to claim 1, wherein said dummy memory cell includes two cell units connected in parallel with said second data line in said data read operation, and said two cell units respectively retain said storage data of different levels.
3. The thin film magnetic memory device according to claim 1, wherein said dummy memory cell includes two cell units connected in series with said second data line in said data read operation, and said two cell units respectively retain said storage data of different levels.
4. The thin film magnetic memory device according to claim 3, wherein said storage data of a level corresponding to a direction of a data write magnetic field is written to each of said memory cell and said cell units, the thin film magnetic memory device further comprising:
a bit line pair formed from two bit lines extending in a same direction, wherein
said two bit lines forming the bit line pair are coupled to each other at their one ends in data write operation so that data write currents of

opposite directions flow therethrough, and

10 said storage data of different levels are written to said two cell units by the data write magnetic fields of opposite directions that are respectively produced by said data write currents respectively flowing through said two bit lines.

5. The thin film magnetic memory device according to claim 1, wherein said plurality of memory cells are arranged in rows and columns on a memory array, and said dummy memory cell is provided in each memory cell column on said memory array by using extra memory cells provided in the row direction as said cell units.

5. The thin film magnetic memory device according to claim 1, wherein said plurality of memory cells are arranged in rows and columns on a memory array, and said dummy memory cell is provided in each memory cell row on said memory array by using extra memory cells provided in the column direction as said cell units.

7. A thin film magnetic memory device, comprising:

a plurality of memory cells for retaining storage data, wherein each of said memory cells includes

an access gate selectively turned ON in data read operation,

5 and

a magnetic storage portion connected in series with said access gate, and having either a first electric resistance or a second electric resistance higher than said first electric resistance depending on said storage data, and

10 said magnetic storage portion includes

a first magnetic layer having a fixed magnetization direction,

a second magnetic layer that is magnetized in a same direction as, or in a direction opposite to, that of said first magnetic layer depending on said storage data to be written, and

15 a first insulating film formed between said first and second

20 magnetic layers, said thin film magnetic memory device further comprising:

20 a data line that is electrically coupled to the magnetic storage portion of a selected memory cell through a turned-ON access gate of said selected memory cell in data read operation, said selected memory cell being a memory cell selected from said plurality of memory cells for said data read operation;

25 a reference data line for transmitting in said data read operation a read reference voltage for comparison with a voltage on said data line; and

25 a plurality of dummy memory cells for producing said read reference voltage, each of said dummy memory cells being provided for every fixed set of said memory cells, wherein

30 each of said dummy memory cells includes

30 a dummy access gate selectively turned ON in said data read operation, and

35 a plurality of dummy magnetic storage portions that are electrically coupled to said reference data line in response to turning-ON of said dummy access gate,

35 each of said dummy magnetic storage portions includes

40 a third magnetic layer that is magnetized in a fixed direction,

40 a fourth magnetic layer that is magnetized either in a same direction as, or in a direction opposite to, that of said third magnetic layer, and

45 a second insulating film formed between said third and fourth magnetic layers, and

50 each of said dummy magnetic storage portions is connected in series with at least one of the remainder.

28. The thin film magnetic memory device according to claim 7, wherein a combined resistance of said plurality of magnetic storage portions is equal to said first electric resistance, and said dummy access gate in an ON state has an electric resistance that is larger than that of said access gate in an ON state by a third electric resistance, said third electric resistance being smaller than a difference between said first and

second electric resistances.

9. The thin film magnetic memory device according to claim 8, wherein said dummy access gate includes a field effect transistor receiving an adjustable control voltage at its gate.

10. The thin film magnetic memory device according to claim 7, wherein a combined resistance of said plurality of dummy magnetic storage portions is equal to a third electric resistance corresponding to an intermediate value of said first and second electric resistances, and said dummy access gate in an ON state has an electric resistance equal to an electric resistance of said access gate in an ON state.

11. The thin film magnetic memory device according to claim 7, wherein, in normal data write operation, said fourth magnetic layer in at least one of said dummy magnetic storage portions is magnetized in parallel with said second magnetic layer in a memory cell selected from said plurality of memory cells for said data write operation.

12. The thin film magnetic memory device according to claim 8, further comprising a test mode for writing prescribed data to each of said dummy memory cells, said test mode being conducted independently of normal operation, wherein said fourth magnetic layer in each of said dummy magnetic storage portions is magnetized in said test mode.

13. A thin film magnetic memory device, comprising:
a plurality of magnetic memory cells for retaining storage data
written by an applied magnetic field; and
a dummy memory cell for generating a read reference voltage in data
read operation, wherein
each of said magnetic memory cells and said dummy memory cell
include
a magnetic storage portion having either a first electric

10 resistance value or a second electric resistance value that is higher than said first electric resistance value depending on a level of said storage data, and

15 an access gate connected in series with said magnetic storage portion, and selectively turned ON, said thin film magnetic memory device further comprising:

20 a first data line that is electrically coupled to a magnetic memory cell selected from said plurality of magnetic memory cells in data read operation so that a data read current is supplied to said first data line;

25 a second data line that is electrically coupled to said dummy memory cell in data read operation so that a data read current equal to that of said first data line is supplied to said second data line;

30 a data read circuit for producing read data based on respective voltages on said first and second data lines; and

35 a resistance adding circuit for adding a third electric resistance in series with said first data line, said third electric resistance being smaller than a difference between said first and second electric resistance values, wherein

40 said magnetic storage portion in said dummy memory cell stores a data level corresponding to said second electric resistance value.

14. The thin film magnetic memory device according to claim 13, wherein said resistance adding circuit includes a field effect transistor receiving a variable control voltage at its gate.

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